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| ECOLOGY |
| 1η εργαστηριακή άσκηση |
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# Pollution

Pollution is the introduction of contaminants into the physical environment that cause adjective change.[1] Pollution can take the form of synthesizedsubstances or energy, such as noise, heat or light. Pollutants, the components of pollution, can be either other substances/energies or naturally occurring contaminants. Pollution is often classed as point source or nonpoint source pollution.

In 2015, pollution killed 9 million people in the world.[2][3] Main forms of pollution include: Air pollution, light pollution, littering, noise pollution, plastic pollution, soil contamination, radioactive contamination, thermal pollution, visual pollution, water pollution. History

## Air pollution

Air pollution has always accompanied civilizations. Pollution started from prehistoric times when man created the first fires. According to a 1983 article in the journal Science, "soot" found on ceilings of prehistoric caves provides ample evidence of the high levels of pollution that was associated with inadequate ventilation of open fires."

Metal forging appears to be a key turning point in the creation of significant air pollution levels outside the home. Core samples of glaciers in Greenland indicate increases in pollution associated with Greek, Roman and Chinese metal production,[5] but at that time the pollution was comparatively small and could be handled by nature.[citation needed]

## Urban pollution

The burning of coal and wood, and the presence of many horses in concentrated areas made the cities the primary sources of pollution. The Industrial Revolution brought an infusion of untreated chemicals and wastes into local streams that served as the water supply.

King Edward I of England banned the burning of sea-coal by proclamation in London in 1272, after its smoke became a problem.[6][7] But the fuel was so common in England that this earliest of names for it was acquired because it could be carted away from some shores by the wheelbarrow.

It was the industrial revolution that gave birth to environmental pollution as we know it today. London also recorded one of the earlier extreme cases of water quality problems with the Great Stink on the Thames of 1858, which led to construction of the London sewerage system soon afterward. Pollution issues escalated as population growth far exceeded view ability of neighborhoods to handle their waste problem. Reformers began to demand sewer systems, and clean water.

# Litter

Litter consists of waste products that have been disposed improperly, without consent, at an inappropriate location. Litter can also be used as a verb. To litter means to drop and leave objects, often man-made, such as aluminum cans, cardboard boxes or plastic bottles on the ground and leave them there indefinitely or for others to dispose of as opposed to disposing of them properly.  
  
 Causes

Platform of Strathfield station in Sydney, Australia. Rubbish accumulated over months, perhaps years due to unsustained periods of frequent cleaning

A small river's valley in India shows extensive littering of plastic and paper. Human waste, illustrated by the urinating man, increase fecal coliform and other bacteria levels in the water.

Littering in nature

In addition to intentional littering, almost half of litter on U.S. roadways is now accidental or unintentional litter, usually debris that falls off improperly secured trash, recycling collection vehicles and pickup trucks.[4] Population levels, traffic density and proximity to waste disposal sites are factors known to correlate with higher litter rates.

Illegally dumped hazardous waste may be a result of the costs of dropping materials at designated sites: some of these charge a fee for depositing hazardous material.[10] Lack of access to nearby facilities that accept hazardous waste may deter use. Additionally, ignorance of the laws that regulate the proper disposal of hazardous waste may cause improper disposal.

According to a study by the Dutch organization VROM, 80% of people claim that "everybody leaves a piece of paper, tin or something, on the street behind".[11] Young people from 12 to 24 years cause more litter than the average (Dutch or Belgian) person; only 18% of people who regularly cause litter were 50 years of age or older. However, a 2010 survey of littering in Maine, New Hampshire and Vermont in the United States, placed litterers aged 55 and over at less than 5%. The same observational study estimated that 78% of litterers are male.[9] In 1999, research by Keep America Beautiful found that 75% of Americans admitted to littering the last five years, yet 99% of the same individuals admitted that they enjoyed a clean environment.

Negligent or lenient law enforcement contributes to littering behavior. Other causes are inconvenience, entitlement and economic conditions. A survey of dumping in Pennsylvania found that the largest number of illegal dumps were in townships without municipal trash hauling.[12] The same report also cites unavailability of curbside trash and recycling service, shortage of enforcement, and habit as possible causes.[13] The presence of litter invites more littering.[14]

## Two-stage process model

The two-stage process model of littering behavior describes the different ways in which people litter. The model was proposed by Chris Sibley and James Liu and differentiates between two types of littering: active and passive.[15]

The theory has implications for understanding the different types of litter reduction interventions that will most effectively reduce littering in a given environment. The theory states that, all things being equal, passive littering will be more resistant to change because of two psychological processes: 1. diffusion of responsibility that increases as the latency between when an individual places litter in the environment and when they vacate the territory, and 2. forgetting, which is also more likely to occur at longer delays between when an individual places litter in the environment and when they vacate the territory.

# Ecosystem

An ecosystem is a community made up of living organisms and nonliving components such as air, water and mineral soil, all interacting as a system.[2] (However, ecosystems can be defined in many ways.[3]) The biotic and abiotic components interact through nutrient cycles and energy flows.[4] Ecosystems are the network of interactions among organisms, and between organisms and their environment.[5] Ecosystems can be of any size but one ecosystem has a specific, limited space.[6] On a larger scale, some scientists view the entire planet as one ecosystem).  
  
Definition

There is no single definition of what constitutes an ecosystem.[3] German ecologist Ernst-Detlef Schulze and coauthors defined an ecosystem as an area which is "uniform regarding the biological turnover, and contains all the fluxes above and below the ground area under consideration." They explicitly reject Gene Likens' use of entire river catchments as "too wide a demarcation" to be a single ecosystem, given the level of heterogeneity within such an area.[11] Other authors have suggested that an ecosystem can encompass a much larger area, even the whole planet.[7] Schulze and coauthors also rejected the idea that a single rotting log could be studied as an ecosystem because the size of the flows between the log and its surroundings are too large, relative to the proportion cycles within the log.[11] Philosopher of science Mark Sagoff considers the failure to define "the kind of object it studies" to be an obstacle to the development of theory in ecosystem ecology.

Ecosystems can be studied through a variety of approaches—theoretical studies, studies monitoring specific ecosystems over long periods of time, those that look at differences between ecosystems to elucidate how they work and direct manipulative experimentation.[12] Studies can be carried out at a variety of scales, from microcosms and mesocosms which serve as simplified representations of ecosystems, through whole-ecosystem studies.[13] American ecologist Stephen R. Carpenter has argued that microcosm experiments can be "irrelevant and diversionary" if they are not carried out in conjunction with field studies carried out at the ecosystem scale, because microcosm experiments often fail to accurately predict ecosystem-level dynamics.

The Hubbard Brook Ecosystem Study, established in the White Mountains, New Hampshire in 1963, was the first successful attempt to study an entire watershed as an ecosystem. The study used stream chemistry as a means of monitoring ecosystem properties, and developed a detailed biogeochemical model of the ecosystem.[15] Long-term research at the site led to the discovery of acid rain in North America in 1972, and was able to document the consequent depletion of soil cations (especially calcium) over the next several decades.

## Related concepts

The term "ecosystem" is often used very imprecisely and linked with a descriptive term (adjective) even if those systems are rather biomes, not ecosystems.[citation needed] Examples include: terrestrial ecosystem or aquatic ecosystems. Aquatic ecosystems are split into marine ecosystems (Large marine ecosystem is another term used) and freshwater ecosystems.

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| **LESSON** | **TOPIC** | **ASSIGNMENT** | **POINTS** | **DUE** |
| 1 | What is Distance Learning? | Wiki #1 | 10 | March 10 |
| Presentation | 20 |  |
| 2 | History & Theories | Brief Paper | 20 | March 24 |
| Spring Break | | | | |
| 3 | Distance  Learners | Discussion #1 | 10 | April 7 |
| Group Project | 50 | April 14 |
| 4 | Media  Selections | Blog #1 | 10 | April 24 |

# lifecycle_apple.gifThermal pollution

Thermal pollution is the degradation of water quality by any process that changes ambient water temperature. A common cause of thermal pollution is the use of water as a coolant by power plants and industrial manufacturers. When water used as a coolant is returned to the natural environment at a higher temperature, the sudden change in temperature decreases oxygen supply and affects ecosystem composition. Fish and other organisms adapted to particular temperature range can be killed by an abrupt change in water temperature (either a rapid increase or decrease) known as "thermal shock."  
  
  
Warm water

Elevated temperature typically decreases the level of dissolved oxygen of water, as gases are less soluble in hotter liquids. This can harm aquatic animals such as fish, amphibians and other aquatic organisms. Thermal pollution may also increase the metabolic rate of aquatic animals, as enzyme activity, resulting in these organisms consuming more food in a shorter time than if their environment were not changed.[5]:179 An increased metabolic rate may result in fewer resources; the more adapted organisms moving in may have an advantage over organisms that are not used to the warmer temperature. As a result, food chains of the old and new environments may be compromised. Some fish species will avoid stream segments or coastal areas adjacent to a thermal discharge. Biodiversity can be decreased as a result.

High temperature limits oxygen dispersion into deeper waters, contributing to anaerobic conditions. This can lead to increased bacteria levels when there is ample food supply. Many aquatic species will fail to reproduce at elevated temperatures.

Primary producers (e.g. plants, cyanobacteria) are affected by warm water because higher water temperature increases plant growth rates, resulting in a shorter lifespan and species overpopulation. This can cause an algae bloom which reduces oxygen levels.

Temperature changes of even one to two degrees Celsius can cause significant changes in organism metabolism and other adverse cellular biology effects. Principal adverse changes can include rendering cell walls less permeable to necessary osmosis, coagulation of cell proteins, and alteration of enzyme metabolism. These cellular level effects can adversely affect mortality and reproduction.

A large increase in temperature can lead to the denaturing of life-supporting enzymes by breaking down hydrogen- and disulphide bonds within the quaternary structure of the enzymes. Decreased enzyme activity in aquatic organisms can cause problems such as the inability to break down lipids, which leads to malnutrition.

In limited cases, warm water has little deleterious effect and may even lead to improved function of the receiving aquatic ecosystem. This phenomenon is seen especially in seasonal waters and is known as thermal enrichment. An extreme case is derived from the aggregational habits of the manatee, which often uses power plant discharge sites during winter. Projections suggest that manatee populations would decline upon the removal of these discharges.

## Cold water

Releases of unnaturally cold water from reservoirs can dramatically change the fish and macroinvertebrate fauna of rivers, and reduce river productivity. In Australia, where many rivers have warmer temperature regimes, native fish species have been eliminated, and macroinvertebrate fauna have been drastically altered. This may be mitigated by designing the dam to release warmer surface waters instead of the colder water at the bottom of the reservoir.

# Ozone depletion

Ozone depletion describes two related phenomena observed since the late 1970s: a steady decline of about four percent in the total amount of ozone in Earth's stratosphere (the ozone layer), and a much larger springtime decrease in stratospheric ozone around Earth's polar regions.[1] The latter phenomenon is referred to as the ozone hole. There are also springtime polar tropospheric ozone depletion events in addition to these stratospheric phenomena.  
  
Ozone cycle overview

Three forms (or allotropes) of oxygen are involved in the ozone-oxygen cycle: oxygen atoms (O or atomic oxygen), oxygen gas (O

2 or diatomic oxygen), and ozone gas (O

3 or triatomic oxygen). Ozone is formed in the stratosphere when oxygen molecules photodissociate after intaking ultraviolet photons. This converts a single O

2 into two atomic oxygen radicals. The atomic oxygen radicals then combine with separate O

2 molecules to create two O

3 molecules. These ozone molecules absorb ultraviolet (UV) light, following which ozone splits into a molecule of O

2 and an oxygen atom. The oxygen atom then joins up with an oxygen molecule to regenerate ozone. This is a continuing process that terminates when an oxygen atom recombines with an ozone molecule to make two O

2 molecules.

O + O

3 → 2 O

2

The total amount of ozone in the stratosphere is determined by a balance between photochemical production and recombination.

Ozone can be destroyed by a number of free radical catalysts; the most important are the hydroxyl radical (OH·), nitric oxide radical (NO·), chlorine radical (Cl·) and bromine radical (Br·). The dot is a notation to indicate that each species has an unpaired electron and is thus extremely reactive. All of these have both natural and man-made sources; at the present time, most of the OH· and NO· in the stratosphere is naturally occurring, but human activity has drastically increased the levels of chlorine and bromine. These elements are found in stable organic compounds, especially chlorofluorocarbons, which can travel to the stratosphere without being destroyed in the troposphere due to their low reactivity. Once in the stratosphere, the Cl and Br atoms are released from the parent compounds by the action of ultraviolet light, e.g.

CFCl

3 + electromagnetic radiation → Cl· + ·CFCl

2

Ozone is a highly reactive molecule that easily reduces to the more stable oxygen form with the assistance of a catalyst. Cl and Br atoms destroy ozone molecules through a variety of catalytic cycles. In the simplest example of such a cycle,[5] a chlorine atom reacts with an ozone molecule (O

3), taking an oxygen atom to form chlorine monoxide (ClO) and leaving an oxygen molecule (O

2). The ClO can react with a second molecule of ozone, releasing the chlorine atom and yielding two molecules of oxygen. The chemical shorthand for these gas-phase reactions is:

Cl· + O

3 → ClO + O

2

A chlorine atom removes an oxygen atom from an ozone molecule to make a ClO molecule

ClO + O

3 → Cl· + 2 O

2

This ClO can also remove an oxygen atom from another ozone molecule; the chlorine is free to repeat this two-step cycle

The overall effect is a decrease in the amount of ozone, though the rate of these processes can be decreased by the effects of null cycles. More complicated mechanisms have also been discovered that lead to ozone destruction in the lower stratosphere.

The ozone cycle

Global monthly average total ozone amount

Lowest value of ozone measured by TOMS each year in the ozone hole

A single chlorine atom would continuously destroy ozone (thus a catalyst) for up to two years (the time scale for transport back down to the troposphere) were it not for reactions that remove them from this cycle by forming reservoir species such as hydrogen chloride (HCl) and chlorine nitrate (ClONO

2). Bromine is even more efficient than chlorine at destroying ozone on a per atom basis, but there is much less bromine in the atmosphere at present. Both chlorine and bromine contribute significantly to overall ozone depletion. Laboratory studies have also shown that fluorine and iodine atoms participate in analogous catalytic cycles. However, fluorine atoms react rapidly with water and methane to form strongly bound HF in the Earth's stratosphere, while organic molecules containing iodine react so rapidly in the lower atmosphere that they do not reach the stratosphere in significant quantities.

A single chlorine atom is able to react with an average of 100,000 ozone molecules before it is removed from the catalytic cycle. This fact plus the amount of chlorine released into the atmosphere yearly by chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) demonstrates the danger of CFCs and HCFCs to the environment.